

REMARKS

Reconsideration of the application is respectfully requested for the following reasons:

1. Amendments to Specification and Claims/Response to Rejection Under 35 USC 112

The specification has been amended to incorporate by reference the foreign priority application, as suggested in item 2 on page 2 of the Official Action.

In addition, claim 1 has been amended by changing “image processing means” to –image processing unit– so as not to invoke 35 USC §112, Paragraph 6, and thereby overcome the rejection under 35 USC §112.

Finally, claims 1, 3, and 14 have been amended to recite that the image matching means includes a systolic array. The systolic array is described, for example, in page 6, lines 26 *et seq.*, page 8, lines 16-18 of the original specification. All other changes to the claims are formal in nature.

2. Rejection of Claims 1-5, 7-9, and 14-15 Under 35 USC §103(a) in view of U.S. Patent No. 5,867,591 (Onda) and U.S. Patent Publication No. 2002/0025075 (Jeong)

This rejection is respectfully traversed on the grounds that the Onda patent and Jeong publication, whether considered individually or in any reasonable combination, fail to disclose or suggest a multi-layered real-time stereo matching system including a multi-layered image matching means that includes a systolic array *which has multiple processing elements exchanging information with two adjacent elements.* Due to the use of the systolic array, the stereo matching system in accordance with the present invention can perform high-speed parallel processing on images output from a pair of cameras and calculated locations of every object in three dimensions.

According to the present invention, the multi-layered image matching means compares one scan line in one of the left and the right digital image with multiple scan lines in the other of the left and the right digital image in real-time by using the systolic array so that each pixel in the one scan line matches another pixel in the multiple scan lines in the other digital image. In other words, the image matching means searches **one corresponding pixel** in the other digital image **to each pixel** in the one digital image. By using this configuration, *the multi-layered real-time stereo matching system can find multiple information of the corresponding pixel, for example, a location of the matching scan line in the other digital image and a correct location of the corresponding pixel.*

In contrast, the Onda patent is totally silent on a systolic array having processing elements which can exchange information with two adjacent processing elements, while the Jeong publication (which shares an inventor in common with the present application) merely discloses left and right image conversion and not the claimed exchange of information between two adjacent processing elements.

As illustrated in Figs. 9, 11, 27 and 28 of the Onda patent, a ternary-value of each pixel in the left window is compared with a ternary-value of pixel of the right window one by one, but the ternary-value of each pixel in left window **does not match** ternary-value of pixels in the right window. In other words, the image matching means of Onda does not search for a pixel in the right window to correspond to each pixel in left window, as in the claimed invention. Instead, the image matching means of Onda only determines a similarity evaluation value of between the left window and the right window. See, especially, Fig. 17 and col. 14, line 48- col 15, line 2 of Onda.

Consequently, Onda only discloses that I) each scan line in left image is compared with multiple scan lines in right image so that the similarity evaluation values between the scan line in left image and multiple scan lines are calculated (See col. 14, line 48 to col. 15, line 2 of Onda); ii) based on the calculated similarity evaluation values, candidate disparities are obtained

for each block (See col. 15, lines 18 to 23 of Onda); and, iii) *one disparity having the largest number of occurrences is determined as the disparity of the block among multiple candidate disparities.* (See col. 15, lines 49-51 of Onda.). Because of these differences, the stereo matching system of Onda cannot find a location of the matching scan line in the other digital image and a correct location of the corresponding pixel, and is structurally and functionally different from the claimed invention. Since Jeong also does not disclose such a stereo matching system, the Jeong patent could not have suggested modification of the system of Onda in the manner claimed, and withdrawal of the rejection of claims 1-5 and 7-9 under 35 USC §103(a) is respectfully requested.

Turning to claim 14, claim 14 recites a multi-layered real-time stereo matching method including the steps of (a) obtaining a left and a right digital image on a spatial area (b) comparing one scan line in one digital image of the left and the right digital image with multiple scan lines in the other digital image in a real-time by using a systolic array to match each pixel in the one scan line with a pixel in the multiple scan lines.

As noted above, Onda is completely silent on any configuration corresponding to the systolic array of the present invention, and further does not disclose the limitation of claim 14, “...comparing one scan line in one digital image of the left and the right digital image with multiple scan lines in the other digital image ... to match each pixel in the one scan line with a pixel in the multiple scan lines ...”

Accordingly, the prior art references including Onda and Jeong, alone or in combination, do not teach, suggest or even imply the limitations of claim 14; and thus, claim 14 is also patentable over the prior art references.

Turning to claim 3, claim 3 is directed to a multi-layered real-time stereo matching system in which the systolic array includes a plurality of layers for receiving pixel data of the one scan line in the one digital image and receiving pixel data of the multiple scan lines in the other

digital image one by one. As a result, one of the plurality of layers stores **both** pixel data of the one scan line in the one digital image and pixel data of one of the multiple scan lines in the other digital image at a time. In addition, claim 3 recites that two adjacent layers exchange costs and active signals with each other.

In contrast, Onda discloses that “u=1” or “BLk(X-1, Y)” in Fig. 18 of Onda (allegedly corresponding to the layer of the present invention) stores values of candidate disparities, rather than pixel data of both the left and right images. Therefore, “u=1” or “BLk(X-1, Y)” of Onda are completely different from the plurality of layers of the present invention., and the subject matter of claim 3 is separately patentable over the cited references.

Further, the outstanding Office Action alleges that “disp1” and “disp2” stored in the layers exchange costs and active signals by adding in a histogram. However, Onda merely teaches that “disp1” and “disp2” stored in the layers are only sent to some location where the histogram is made, which is not “exchange costs and active signals with each other.” Accordingly, Onda fails to disclose or even imply that the recitation of claim 3 of the present invention, “two adjacent layers exchange costs and active signals with each other.”

CONCLUSION

Applicants believe that this is a full and complete response to the Office Action. For the reasons discussed above, applicants now respectfully submit that all of the pending claims are in complete condition for allowance. Accordingly, it is respectfully requested that the Examiner's rejections be withdrawn; and that the pending claims be allowed in their present form. If the Examiner feels that any issues that remain require discussions, he is kindly invited to contact applicants' undersigned attorney to resolve the issues.

Should the Examiner require or consider it advisable that the specification, claims an/or drawings be further amended or corrected in formal respects, in order to place the case in condition

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for final allowance, then it is respectfully requested that such amendment or correction be carried out by Examiner's Amendment and the case be passed to issue.

Alternatively, should the Examiner feel that a personal discussion might be helpful in advancing this case to allowance, the Examiner is invited to telephone the undersigned at any time.

Respectfully submitted,

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